(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 642 675 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
02.09.1998 Bulletin 1998/36

(21) Application number: **93910533.4**

(22) Date of filing: **14.05.1993**

(51) Int Cl.[6]: **G02B 6/38**

(86) International application number:
PCT/SE93/00430

(87) International publication number:
WO 93/23777 (25.11.1993 Gazette 1993/28)

(54) **CONNECTION DEVICE FOR OPTICAL FIBRES**

VERBINDUNGSVORRICHTUNG FÜR OPTISCHE FASERN

DISPOSITIF DE CONNEXION POUR FIBRES OPTIQUES

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **19.05.1992 SE 9201571**

(43) Date of publication of application:
15.03.1995 Bulletin 1995/11

(73) Proprietor: **STIFTELSEN INSTITUTET FÖR MIKROELEKTRONIK**
S-164 21 Kista (SE)

(72) Inventors:
- **ELDERSTIG, Hakan**
  S-161 41 Bromma (SE)
- **VIEIDER, Christian**
  S-752 33 Uppsala (SE)

(74) Representative: **Örtenblad, Bertil Tore et al**
Noréns Patentbyra AB
P.O. Box 10198
100 55 Stockholm (SE)

(56) References cited:
DE-A- 3 809 037
US-A- 4 475 790
US-A- 4 629 284
US-A- 4 950 048

EP 0 642 675 B1

Printed by Jouve, 75001 PARIS (FR)

Description

The present invention relates to a connecting device for optical fibres.

When optical fibres are used as information carrying media, it is often necessary to join the fibres together and also to connect the fibres to light-transmitting and light-receiving units.

The present invention relates to a device for mutually connecting different kinds of fibres. Thus, the inventive connecting device can be used to join both plastic fibres and glass fibres.

A connecting device which is comprised essentially of an homogenous cylinder having a through-penetrating hole which extends along the cylinder axis is known to the art. At each end of the cylinder, there is provided a funnel-shaped recess which is symmetrical with respect to the cylinder axis and which leads to the throughpassing hole. The connecting device is made from a non-transparent material.

When using this known device, the ends of respective fibres are inserted into the funnel-shaped recess and then guided into the throughpassing hole, so as to meet one another within the device.

This known fibre-connecting device is expensive to manufacture and is encumbered with several decisive drawbacks. One drawback is that it is difficult to achieve sufficient precision with regard to the diameter of the throughpassing hole. The hole diameter should be precise to a tolerance of less than about 1 micrometer in order for the fibre ends to meet one another in the manner desired, i.e. with sufficient overlap of the fibre cores. Another drawback is that the connecting device is intended only for one single join. A further, serious drawback is that it is not possible to see or check the positions of the fibre ends in the fibre- connecting device.

US 4,950,048 shows an optical connector comprising two ferrules, where one fibre is inserted in one ferrule, and another fibre in a second ferrule, whereafter the ferrules are connected to each other via a connector. Funnel-shaped parts at one end of each ferrule leading to guide grooves in the ferrules are resin-molded.

There is an apparent drawback with this device, namely that several parts are involved in order to connect two fibres to each other.

US 4,475,790 shows a coupler where two complementary opposed V-grooves from a channel. The channel is provided with a thin layer of deformable hard glass lining in order to allow variations in fibre size. The two parts of the coupler is bonded together after that the fibre has been inserted. This is a very great disadvantage. Further, it is expensive to manufacture because many operational steps must be carried out.

These drawbacks are eliminated by means of the present invention, which provides a fibre-connecting device of high precision and of relatively inexpensive manufacture.

Accordingly, the present invention relates to an optical fibre-connecting device comprising a passageway which is funnel-shaped at both ends thereof and with which an optical fibre is intended to be inserted into the passageway from either end thereof, so that the fibres will meet one another in the passageway, wherein the connecting device includes a first silicon part having a flat surface in which one groove of V-shaped cross-section has been etched and wherein the connecting device includes a second part covering said groove so that a channel with a triangular cross section is formed, which second part is made of a glass material and which second part has a flat side lying against the grooved surface of the first part and is characterized in that during said etching the V-shaped groove has been etched to a deeper and wider section at opposite ends of the first silicon part, so as to form a funnel-shaped section at said each device end, in that said second part is made from transparent glass material and in that the first and the second parts are joined together by means of an anodic bond whereby said channel of triangular cross-section is formed, wherein a circle inscribed in said channel will have a diameter which only slightly exceeds the outer diameter of the optical fibre.

The invention will now be described in more detail with reference to the exemplifying embodiments thereof and also with reference to the accompanying drawings, in which

- Figure 1 is a longitudinal sectional view of an inventive connecting device;
- Figure 2 is a perspective view of part of a connecting device;
- Figure 3 illustrates part of a connecting device according to Figure 1 seen from above;
- Figure 4 is a side view of part of a connecting device and an adapter;
- Figure 5 illustrates the connecting device and adapter of Figure 4 from above;
- Figure 6 illustrates an embodiment of the connecting device in which the device functions as a coupling unit;
- Figure 7 illustrates schematically a complete coupling unit which includes the connecting device; and
- Figure 8 illustrates one end of a so-called ribbon.

Figure 1 illustrates an optical fibre-connecting device 1 which comprises a passageway 2 which is funnel-shaped at both ends 3, 4 thereof, where an optical fibre 5, 6 is intended to be inserted into the passageway from each end, as shown by the arrows, so that the optical fibres will meet in the passageway.

According to the invention, the connecting device includes a first silicon part 7 having a flat surface in which one or more grooves 8 of V-shaped cross-section have been etched. The connecting device also includes a second part 9, which is made of transparent glass material. The second part 9 has a flat side 10 which is intended to lie against the grooved surface 11 of the first

part 7, such as to form a channel of triangular cross-section. A circle inscribed in this channel will have a diameter which only slightly exceeds the outer diameter of the optical fibre.

Each of the V-shaped grooves 8 at opposing ends 3, 4 of the connecting device has a deeper and broader section 12, such as to provide a funnel-shaped section at each said end 3, 4, as shown in Figures 1 and 3. Figure 3 illustrates in dark, broad lines, the flat ridges 13 that extend between the V-shaped grooves 8.

According to one greatly preferred embodiment of the invention, the aforesaid first part of the connecting device is comprised of crystalline silicon having the crystal direction **[100]**. In practice, the first part of the connecting device is conveniently produced from a crystalline silicon plate having the crystal direction **[100]**, a thickness of 525 micrometers and a diameter of 4 inches, i.e. a standard silicon sheet.

This choice of material will enable the grooves 8 to be wet-etched with the aid of a conventional photolithographic mask. The grooves are etched by applying a mask whose extension corresponds to the ridges 13. An anisotropic wet-etching process is then carried out, for instance with potassium hydroxide (KOH). The plate, or sheet, is etched to obtain the crystal plane **[111]**. The etching process is halted where these planes meet, V-shaped grooves having flat sides which define an angle of 54.7° with the upper surface of the plate being formed. The etching process is continued outside the mask, so as to form the funnel-shaped sections 12.

The aforedescribed method results in very high precision with regard to the dimensions and positions of the grooves 8.

According to another preferred embodiment, the second part 9 of the connecting device is comprised of silicate glass, preferably a boron silicate glass. Boron glass is preferred because it has generally the same coefficient of linear expansion as silicon. The glass will preferably have a thickness of about 0.5 millimeter.

After completion of the etching process, the flat undersurface of the second part 9 of the connecting device is placed on the first part 7 thereof. The parts 7, 9 are then joined together, preferably with the aid of an anodic bonding process. Bonding can be achieved by applying a voltage, e.g. a voltage of 800 Volts, vertically in Figure 1, at a temperature of about 450°C.

The advantage of anodic bonding is that no glue need be used. When glue is used, there is a risk that glue may enter the grooves. Furthermore, it may be difficult to determine the thickness of glue joints, meaning that the cross-section of the grooves will not be well defined.

The grooves 8 thus have a cross-section in the shape of an isosceles triangle, into which the fibres are inserted.

Naturally, the precision to which the fibres are positioned in the groove will depend on how much smaller the outer diameter of the fibres is than the diameter of the circle inscribed in the groove. Ideally, the outer diameter of the fibre will coincide with the diameter of the inscribed circle. However, a certain degree of clearance must be found between fibre and groove, in order for it to be possible to insert the fibre into the groove.

A glass fibre which includes an optically conductive core will typically have an outer diameter of 125 micrometers. The optically conductive core has typically a diameter of 5 micrometers. The intention is that two fibre ends shall meet in the connecting device, as illustrated in Figure 1, such that the cores will lie opposite one another. The cores should not be displaced radially in relation to one another by more than one micrometer.

According to one preferred embodiment, when the connecting device is intended to join together optical fibres that include an optically conductive core, the connecting device is so constructed that the outer diameter of the inscribed circle will exceed the outer diameter of the fibre by at most 25% of the core diameter, preferably by at most 10% of said core diameter.

When effecting a join, a so-called index matching liquid 14 is introduced into the passageway, by applying the liquid to one or both ends of the fibres prior to inserting the fibres into the connecting device. The index-matching liquid is a liquid which has the same refractive index as the core material. The index-matching liquid may be an oil, for instance. The skilled person is able to select an appropriate liquid according to the fibre material concerned. This liquid assists in maintaining low transition losses at the fibre join and also has a certain lubricating effect which facilitates insertion of the fibres into the connecting device.

Subsequent to having placed the fibres in the connecting device in the intended manner, glue 15 is applied to the ends of said device so as to fixate the fibres.

In the illustrated embodiment, each connecting device includes a number of grooves 8. It will be understood, however, that the connecting device can be constructed to include solely one single groove. When the device includes several grooves, a suitable groove spacing is 250 micrometers.

The inventive optical fibre-connecting device has three decisive advantages. Firstly, the device is extremely precise with regard to the dimensions and positions of the grooves. Secondly, and very importantly, the fibre ends can be seen through the glass. This can be achieved in practice with the naked eye, without needing to use optical auxiliaries. This enables the positions of the fibres to be readily checked. Thirdly, the inventive optical fibre-connecting device can be manufactured cheaply. For instance, the silicon part of about 100 connecting devices can be produced simultaneously from a single silicon plate 4 inches in thickness.

The present invention therefore provides a significant advantage in comparison with known techniques.

According to one preferred embodiment, insertion of the fibres is facilitated by means of an adapter 16, shown in Figures 4 and 5, which is intended to lie against

the ends 3, 4 of the connecting device 1 where the triangular channels open out, at least when inserting the fibres into said device. The adapter 16 includes a V-shaped groove 17 for each of the triangular channels 8 of the connecting device 1. The V-shaped adapter groove 17 widens and deepens in an outward direction out from the connecting device.

The adapter 17 may be made of a plastic material. The adapter 16 may also be provided with a recess 18 which connects with the connecting device 1, so as to enable the connecting device to be positioned more readily in relation to the adapter 16. Because the adapter groove widens in an outward direction out from the connecting device, a fibre 6 can be placed easily in a groove in the adapter. As the fibre is then pushed towards the connecting device the fibre will be guided into the actual connecting device by means of the adapter 16.

According to one preferred embodiment of the invention, the groove 17 in the adapter 16 is curved in the symmetry plane extending through the bottoms of respective V-shaped grooves, i.e. the adapter curves outwardly from the connecting device, as illustrated in Figure 4. Reference numeral 19 identifies the bottom of a groove 17, which is shown to extend in a curved path.

The main reason, and an important reason, for this construction is that because the fibre is moved in a curved path the leading end of the fibre will be pressed against the bottom of the groove 8 in the connecting device. This means that the fibre will be positioned against the groove bottom when a gap is found between the outer surface of the fibre and the walls of the triangular groove. When the fibre introduced into the connecting device from the other end thereof is also inserted with the aid of the adapter, this fibre will also be positioned against the bottom of the groove in the connecting device. Thus, the two fibres will be well-positioned in relation to one another, even when the outer diameters of the fibres are smaller than the diameter of the inscribed circle to a greater extent than the diameter of the fibre cores. When using an adapter 16 with the aforesaid curved groove, glue 15 is applied so as to lock the fibre in position after having inserted the fibre into the connecting device.

The present invention can be applied to join single fibres or two or more fibres. The number of grooves included in a connecting device will therefore depend on the actual application of the device.

So-called fibre ribbons can also be connected. A so-called fibre ribbon 30 is a ribbon which contains a number of mutually parallel fibres 31. Each fibre is embedded in a cladding layer 32. The fibres are supported by a plastic casing 33; see Figure 8.

Figure 8 illustrates one end of a ribbon and shows part of the plastic casing peeled away and part of the cladding layers stripped-off.

When the distance between the grooves 8 is 250 micro-meters, which corresponds to the distance between the fibres in the ribbon 30, all fibres can be joined at one and the same time, by introducing the end of the ribbon to a connecting device which has at least as many grooves as there are fibres in the ribbon.

In the aforegoing, the connecting device has been described solely with reference to its use in achieving a permanent fibre connection. According to one preferred embodiment, however, the connecting device may have the form of a coupling unit 20, 21, see Figures 6 and 7, with which one or more fibres 22 is/are inserted into the connecting device 1 from one side 23 thereof and fastened in relation to said device, and with which the other side 24 of the connecting device is intended to receive fibres 25 for insertion of said fibres into said device.

That side of the connecting device in which the fibres are permanently inserted may be moulded in a plastic holder 30; see Figure 6.

The connecting device 1 may be embraced by a female part 26 of a conventional coupling unit, for instance a coupling unit of the kind used to connect together electrical conductors, see Figure 7, said female part being provided with hooks 27 which coact with hooks 28 on a male part 29 of the coupling unit. In this case, the male part 29 carries fibres 25 which are spaced apart at a distance corresponding to the spacing of the grooves in the connecting device.

The coupling unit is preferably configured so that the male and female parts will include conventional guides (not shown) which function to bring the male part to a correct position in relation to the female part prior to said parts being pressed together and thus prior to the fibres 25 being led into the connecting device 1. According to one embodiment, the coupling unit is of a kind in which the female and male parts can be pushed together and mutually separated.

When concerning coupling units of this nature, it is advantageous to proceed from the aforesaid ribbon 30 which is provided with a male part 29.

It will be evident from the aforegoing that the present invention overcomes the drawbacks mentioned in the introduction and provides a highly advantageous connecting device.

The invention has been described in the aforegoing with reference to different exemplifying embodiments thereof. It will be understood, however, that the present invention can be varied with regard to dimensions and structural details.

The present invention shall not therefore be considered limited to the aforedescribed embodiments thereof, since modifications and variations can be made within the scope of the following Claims.

Claims

1. An optical fibre-connecting device comprising a passageway which is funnel-shaped at both ends thereof and with which an optical fibre is intended

to be inserted into the passageway from either end thereof, so that the fibres will meet one another in the passageway, wherein the connecting device (1) includes a first silicon part (7) having a flat surface in which one groove (8) of V-shaped cross-section has been provided and wherein the connecting device (1) includes a second part (9) covering said groove so that a channel with a triangular cross section is formed, which second part (9) is made of a glass material and which second part has a flat side lying against the grooved surface of the first part (7), **characterized** in that during said etching the V-shaped groove (8) has been etched to a deeper and wider section at opposite ends (3,4) of the first silicon part (7), so as to form a funnel-shaped section (12) at said each device end (3,4), in that said second part (9) is made from transparent glass material and in that the first and the second parts (7,9) are joined together by means of an anodic bond whereby said channel of triangular cross-section is formed, wherein a circle inscribed in said channel will have a diameter which only slightly exceeds the outer diameter of the optical fibre (5,6).

2. A device according to Claim 1, **characterized** in that when the connecting device (1) is intended to mutually connect optical fibres that include a light conductive core, the outer diameter of said inscribed circle will exceed the outer diameter of the fibre (5,6) by at most 25% of the core diameter, preferably at most 10% of the core diameter.

3. A device according to Claim 1 or 2, **characterized** in that the device comprises two or more parallel grooves (8), which together with said funnel-shaped section (12) are made by etching.

4. A device according to Claim 1, 2 or 3, **characterized** in that the first part (7) is comprised of crystalline silicon having the crystal direction [1 0 0]; and in that the second part (9) is comprised of silicate glass, preferably a boron silicate glass.

5. A device according to Claim 1, 2, 3 or 4, **characterized** in that the connecting device (1) includes an adapter (16) which is intended to lie against the end (3;4) of the connecting device (1) where the triangular channels open out, at least when inserting a fibre into said connecting device; and in that the adapter includes a V-shaped groove (17) for each of the triangular channels of the connecting device, said V-shaped grooves (17) widening and deepening in an outward direction out from the connecting device (1).

6. A device according to Claim 5, **characterized** in that the grooves (17) of said adapter (16) curve in the symmetry plane that extends through the bottoms of respective V-shaped grooves (17).

7. A device according to any one of the preceding Claims, **characterized** in that the connecting device (1) forms a coupling unit in which one or more fibres (22) is/are inserted into the connecting device from one side (23) thereof and fastened in relation to the connecting device, and with which the other side (24) of the connecting device is intended to receive fibres (25).

8. A device according to any one of the preceding Claims, **characterized** in that said first part is a silicon plate having a thickness of 525 micro-meters; and in that said second part is a glass plate having a thickness of about 0.5 millimeter.

9. A device according to any one of the preceding Claims, **characterized** in that the grooves (8) have a mutual spacing of 250 micrometers.

Patentansprüche

1. Verbindungsvorrichtung für optische Fasern, mit einem Durchgang, der an seinen beiden Enden trichterförmig gestaltet ist und der dafür vorgesehen ist, daß von seinen beiden Seiten eine optische Faser in den Durchgang hineingeführt wird. so daß sich die Fasern im Durchgang treffen, wobei die Verbindungsvorrichtung (1) einen ersten Silikonteil (7) aufweist, der eine flache Oberfläche hat, in der eine Rille (8) mit V-förmigem Querschnitt vorgesehen ist und wobei die Verbindungsvorrichtung (1) einen zweiten Teil (9) aufweist, der die Rille so bedeckt, daß ein Kanal mit dreieckigem Querschnitt geformt wird, wobei der zweite Teil (9) aus einem Glasmaterial besteht und wobei der zweite Teil eine flache Seite aufweist, die gegen die gerillte Oberfläche des ersten Teils (7) anliegt, dadurch **gekennzeichnet**, daß während des Ätzens die V-förmige Rille (8) an gegenüberliegenden Enden (3, 4) des ersten Silikonteils (7) auf einen tieferen und breiteren Querschnitt geätzt wurde. um an jedem Vorrichtungsende (3, 4) einen trichterförmigen Querschnitt (12) zu bilden, daß der zweite Teil (9) aus transparentem Glasmaterial besteht und daß der erste und der zweite Teil (7, 9) miteinander mittels eines anodischen Verbinders verbunden werden, wodurch der Kanal mit dreieckigem Querschnitt gebildet wird. wobei ein in dem Kanal einbeschriebener Kreis einen Durchmesser aufweist. der nur leicht den äußeren Durchmesser der optischen Faser (5, 6) überschreitet.

2. Vorrichtung nach Anspruch 1, dadurch **gekennzeichnet**, daß für den Fall, daß die Verbindungsvorrichtung (1) zur gegenseitigen Verbindung von

optischen Fasern vorgesehen ist, die einen lichtleitfähigen Kern aufweisen, der äußere Durchmesser des einbeschriebenen Kreises den äußeren Durchmesser der Faser (5, 6) um höchstens 25 % des Kerndurchmessers überragt, vorzugsweise höchstens 10 % des Kerndurchmessers.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch **gekennzeichnet,** daß die Vorrichtung zwei oder mehr parallele Rillen (8) aufweist, die zusammen mit dem trichterförmigen Querschnitt (12) durch Ätzen hergestellt sind.

4. Vorrichtung nach Anspruch 1. 2 oder 3, dadurch **gekennzeichnet,** daß der erste Teil (7) aus kristallinem Silikon mit der Kristallausrichtung [1 0 0] besteht, und daß der zweite Teil (9) aus Silikatglas, vorzugsweise Borsilikatglas besteht.

5. Vorrichtung nach Anspruch 1, 2, 3 oder 4, dadurch **gekennzeichnet,** daß die Verbindungsvorrichtung (1) einen Adapter (16) aufweist, der dafür vorgesehen ist, gegen das Ende (3; 4) der Verbindungsvorrichtung (1) anzuliegen, wo sich der dreieckige Kanal nach außen öffnet, wenigstens wenn eine Faser in die Verbindungsvorrichtung eingeführt wird, und daß der Adapter für jeden dreieckigen Kanal der Verbindungsvorrichtung eine V-förmige Rille (17) aufweist, wobei die V-förmigen Rillen (17) sich in einer nach außen gehenden Richtung aus der Verbindungsvorrichtung (1) heraus verbreitern und -tiefen.

6. Vorrichtung nach Anspruch 5, dadurch **gekennzeichnet,** daß die Rillen (17) des Adapters (16) sich in der Symmetrieebene krümmen, die sich durch den Boden der entsprechenden V-förmigen Rillen (17) erstreckt.

7. Vorrichtung nach einem der vorangehenden Ansprüche, dadurch **gekennzeichnet,** daß die Verbindungsvorrichtung (1) eine Kupplungseinheit bildet, in der eine oder mehrere Fasern (22) in die Verbindungsvorrichtung von einer ihrer Seiten (23) eingeführt wird/werden und in Bezug auf die Verbindungsvorrichtung befestigt wird/werden, und wobei die andere Seite (24) der Verbindungsvorrichtung zur Aufnahme von Fasern (25) vorgesehen ist.

8. Vorrichtung nach einem der vorangehenden Ansprüche, dadurch **gekennzeichnet,** daß der erste Teil eine Silikonplatte mit einer Dicke von 525 µm ist, und daß der zweite Teil eine Glasplatte mit einer Dicke von etwa 0,5 mm ist.

9. Vorrichtung nach einem der vorangehenden Ansprüche, dadurch **gekennzeichnet,** daß die Rillen (8) einen gegenseitigen Abstand von 250 µm haben.

Revendications

1. Dispositif de connexion pour fibres optiques, comprenant un passage en forme d'entonnoir à ses deux extrémités, passage dans lequel une fibre optique est destinée à être introduite par l'une ou l'autre de ses extrémités, de façon que les fibres se rejoignent l'une l'autre dans le passage, le dispositif de connexion (1) comprenant une première partie en silicium (7) munie d'une surface plate dans laquelle une rainure (8) à section transversale en forme de V a été formée, et le dispositif de connexion (1) comprenant une seconde partie (9) recouvrant la rainure de manière à former un canal à section transversale triangulaires, la seconde partie (9) étant réalisée en matériau de verre et cette seconde partie comportant un côté plat se situant contre la surface rainurée de la première partie (7), caractérisé en ce que

   - pendant la gravure à l'acide de la rainure en forme de v (8), celle-ci a été attaquée à une section plus profonde et plus large aux extrémités opposées (3, 4) de la première partie en silicium (7), de manière à former une section en forme d'entonnoir (12) à chaque extrémité (3, 4) du dispositif,
   - la seconde partie (9) est réalisée dans un matériau de verre transparent, et
   - la première partie et la seconde partie (7, 9) sont reliées l'une à l'autre au moyen d'un assemblage anodique de manière à former le canal à section transversale triangulaire, un cercle inscrit dans le canal devant avoir un diamètre légèrement supérieur seulement au diamètre extérieur de la fibre optique (5, 6).

2. Dispositif selon la revendication 1, caractérisé en ce que lorsque le dispositif de connexion (1) est destiné à connecter mutuellement des fibres optiques comprenant un noyau conducteur de lumière, le diamètre extérieur du cercle inscrit doit dépasser le diamètre extérieur de la fibre (5, 6) d'au moins 25 % du diamètre du noyau, et de préférence de plus de 10 % du diamètre du noyau.

3. Dispositif selon la revendication 1 ou 2, caractérisé en ce qu' il comprend deux ou plusieurs rainures parallèles (8) qui sont réalisées par gravure à l'acide en même temps que la section en forme d'entonnoir (12).

4. Dispositif selon la revendication 1, 2 ou 3, caractérisé en ce que

la première partie (7) est constituée de silicium cristallin de directions de cristaux [100] ; et
la seconde partie (9) est constituée d'un verre au silicate, de préférence un verre au silicate de bore.

5. Dispositif selon la revendication 1, 2, 3 ou 4, caractérisé en ce que
le dispositif de connexion (1) comprend un adaptateur (16) destiné à se placer contre l'extrémité (3 ; 4) de ce dispositif de connexion (1) à l'endroit où débouchent les canaux triangulaires, au moins lorsqu'on introduit une fibre dans le dispositif de connexion ; et
l'adaptateur comprend une rainure en forme de V (17) pour chacun des canaux triangulaires du dispositif de connexion, ces rainures en forme de V (17) s'élargissant et s'approfondissant dans une direction dirigée vers l'extérieur en sortant du dispositif de connexion (1).

6. Dispositif selon la revendication 5, caractérisé en ce que
les rainures (17) de l'adaptateur (16) s'incurvent dans le plan de symétrie s'étendant à travers les fonds des rainures en forme de V respectives (17).

7. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que
le dispositif de connexion (1) forme un bloc d'accouplement dans lequel une ou plusieurs fibres (22) est/sont introduites dans le dispositif de connexion par un côté (23) de celui-ci, et sont fixées par rapport au dispositif de connexion, et avec lequel l'autre côté (24) du dispositif ae connexion est destiné à recevoir des fibres (25).

8. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que
la première partie est une plaque de silicium de 525 micromètres d'épaisseur ; et la seconde partie est une plaque de verre d'environ 0,5 millimètre d'épaisseur.

9. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que
les rainures (8) ont un espacement mutuel de 250 micromètres.

Fig.1

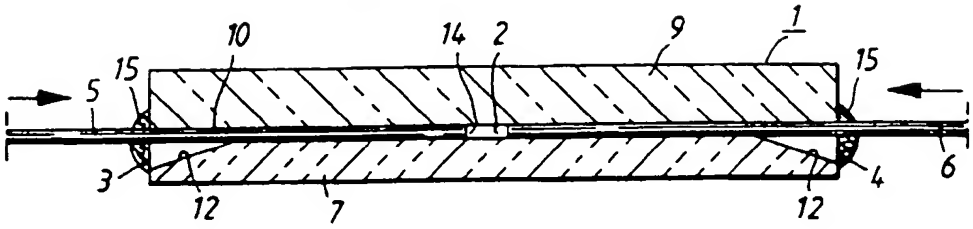

Fig.2

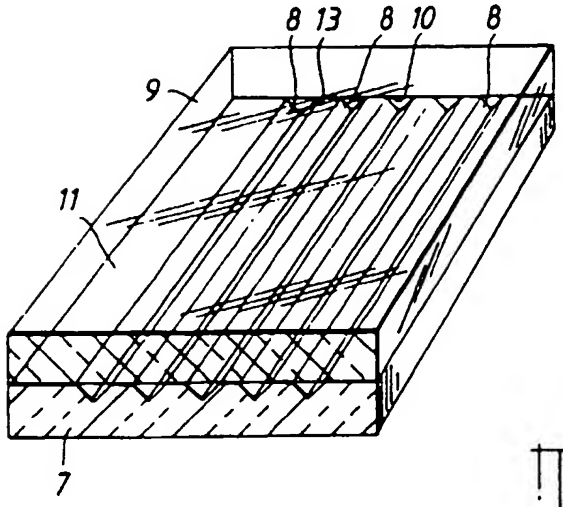

Fig.3

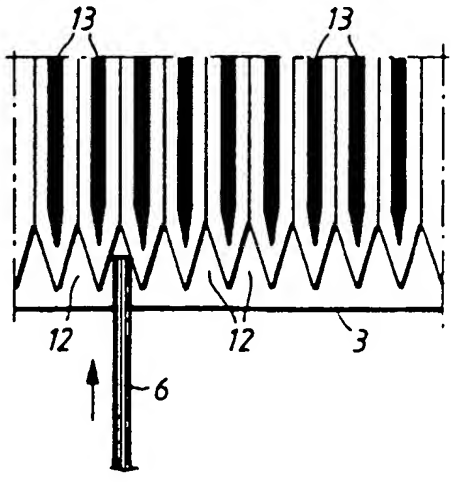

Fig. 4

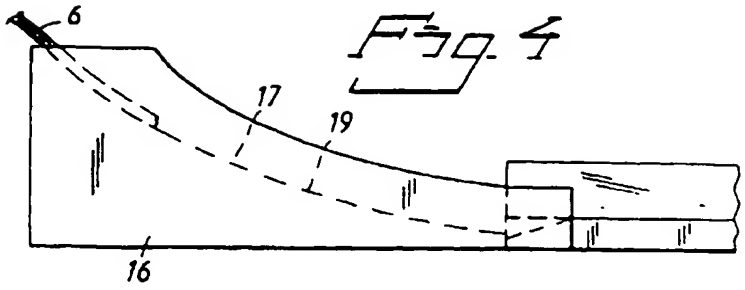

Fig. 5

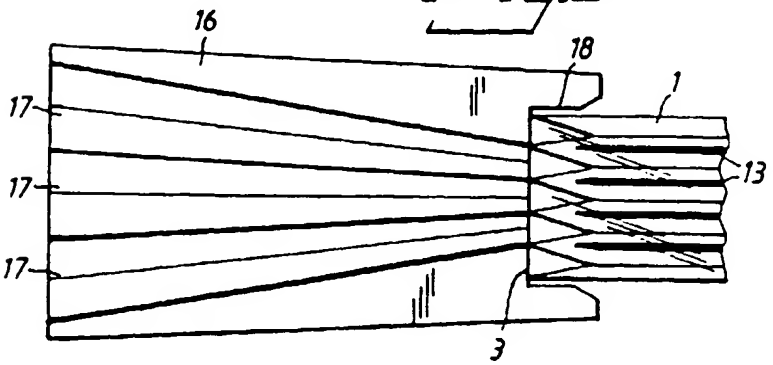

Fig. 6

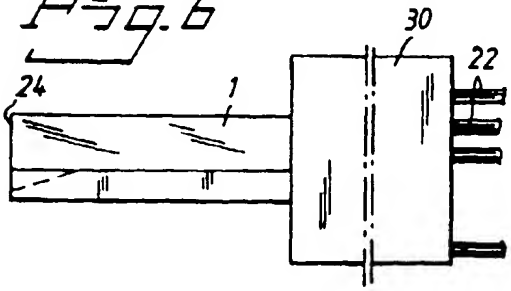

Fig. 7

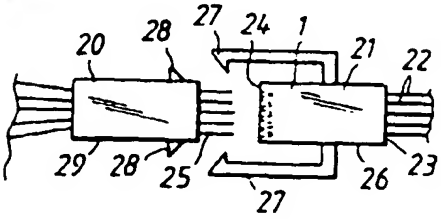

Fig. 8